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CASE REPORT

Totally submuscular implantation of subcutaneous implantable cardioverter defibrillator: a safe and effective solution for obese or oversized patients

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Key Clinical Message

The subcutaneous implantable cardioverter–defibrillator (S-ICD) is a safe alternative to transvenous ICD. We describe a submuscular S-ICD placement technique in a severely obese with an oversized chest. Submuscular configuration allows optimal system positioning and impendence values warranting a safe and effective shock transmission. This technique is safe and improves patients comfort.

Keywords

Obesity, subcutaneous defibrillator, submuscular technique, sudden cardiac death.

The subcutaneous implantable cardioverter–defibrillator (S-ICD) is an important therapeutic option and may be considered as a useful alternative to the transvenous ICD system when venous access is difficult, after the removal of a transvenous ICD for infections or in young patients with a long-term need ICD therapy; nonetheless, it is not appropriate for patients needing bradycardia pacing, antitachycardia pacing, or resynchronization therapy (2015 ESC guidelines) [1]. It could be implanted in patients affected by congenital cardiac disease and with inherited arrhythmic diseases as Brugada syndrome or hypertrophic cardiomyopathy or chronic venous obstructions [2–4]. In this report, a 60-year-old man severely obese (Grade III overweight, 180 cm, 160 Kg, BMI 49.4), with ischemic cardiomyopathy (acute myocardial infarction in 2014), left ventricular ejection fraction 30%, QRS duration 100 msec, NYHA class II, arterial hypertension, and diabetes mellitus type II, attempted implantation of a transvenous defibrillator (ICD) for primary prevention of sudden cardiac death in 2014.

Due to the conformation of the patient, we failed a cephalic or axillary approach. After repeated attempts to perform a successful subclavian vein puncture, with an increasing risk of potentially serious acute complications, including pneumothorax, hemothorax, and brachial plexus injury, the decision was taken to attempt S-ICD implantation. The patient gave his informed consent to the surgery.

He was placed in the supine position with the left upper limb abducted (90°), palm down, and a pillow under the left hemithorax (30° inclination). Deep sedation was achieved by administration of propofol and fentanyl, without orotracheal intubation.

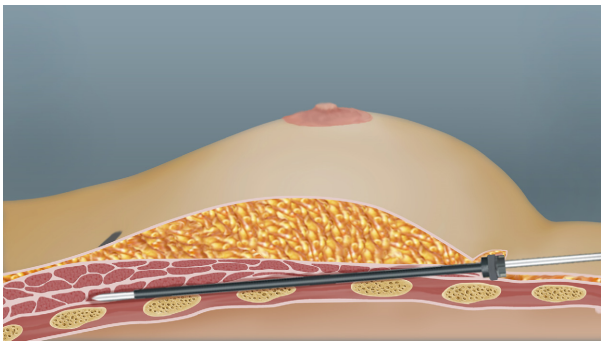

Figure 1. Subpectoral tunneling of the lead to reach the standard parasternal location.

An A-P chest film was obtained to determine the ideal system layout. Due to the large thoracic size, the standard subcutaneous positioning of the device and lead could not afford the required configuration, with the shock vector close to the center of the ventricular myocardial mass. Thus, in order to reduce the distance between the device and the sternal border (target localization for the lead coil), a submuscular pocket was created between the serratus anterior and latissimus dorsi muscles, at the level of the VI-VII rib. The lead was subcutaneously tunneled to the standard parasternal location.

Ventricular fibrillation was induced to test the system. However, a 65 J and a 80 J shock was not effective, and the arrhythmia was terminated by external defibrillation. Although in the acceptable range, the measured S-ICD shock impedance was very high (165 Ohms). At this point, in order to avoid system explant, the coil was relocated by a submuscular route, under the pectoralis major muscle. The fascia was incised and the muscle fibers separated in the costochondral area, in order to retunnel the coil along the parasternal line. Coil fixation was achieved by a nonabsorbable stitch (Fig. 1).

A new impedance test was carried out, with 10 J. With the coil in the submuscular location, the new impedance value was equal to 55 Ohms. This value was considered acceptable, and the surgical wounds were closed. We decided to perform an additional DF test despite the detection of a good new shock impedance due to the risk of high DFT threshold for this specific patient. Ventricular fibrillation was induced and successfully terminated by a 65 J shock. The postoperative course was uneventful.

Discussion

Severe obesity can complicate the S-ICD implantation procedure, as the reported case demonstrates. Submuscular routing appears as a valid and practical solution. Currently, the S-ICD system is equipped with a single 45-cm-long lead, and in patients with an oversized chest, this length may be insufficient to ensure an appropriate subcutaneous path so to achieve correct positioning and an optimal defibrillation vector. In the present report, we describe a totally submuscular S-ICD placement technique to overcome such limitation. Submuscular routing of the lead shortens the path between the perixiphoid region and the device pocket. It requires a submuscular pocket for the device and tunneling of the lead under the pectoralis major, directly on the chest-wall bony surface. This allows optimal system positioning. This technique, after a short learning curve, can easily performed as it uses an anatomical pocket already present in the lateral thoracic wall, formed by the latissimus dorsi muscle lying over the serratus anterior. This pocket is deeper than its subcutaneous equivalent and is an excellent site for the S-ICD that results almost imperceptible when totally covered by the latissimus dorsi, which provides excellent protection. Furthermore, the impedance values, too high for ideal system effectiveness when the subcutaneous route is utilized in oversized patients, are relocated within the optimal range by the submuscular option, warranting a safe and effective shock transmission. The achievement of an optimal shock impedance could eliminate the need for repeat system testing and reprogramming, reducing at the start the possibilities of cardioversion failures. Severely obese or oversized patients are less-than-ideal candidates for S-ICD implantation. Submuscular device positioning and lead routing are a feasible solution, reducing the distance the coil must cover on the chest. Additionally, the submuscular path keeps impedance values within the optimal range, warranting a safe and effective function of the S-ICD. Such statement does not hold true with the subcutaneous route for which impedance values are much higher in this class of patients, entailing ineffective shock transmission and reduced cardioversion efficacy. Last but not least, in thin subjects, submuscular positioning affords better cosmetic results and comfort. The technique is safe and learning curve straightforward.

Obviously, our preliminary results should be evaluated by prospective clinical trials with large populations to assess long-term safety and efficacy of this approach.

Conflict of Interest

Dr. Droghetti is a Consultant of Boston Scientific. M. Malacrida and M. Arupi are salaried Boston Scientific employee.

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